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SCIENCE NEWS-LETTER

The Weekly Summary of Current Science

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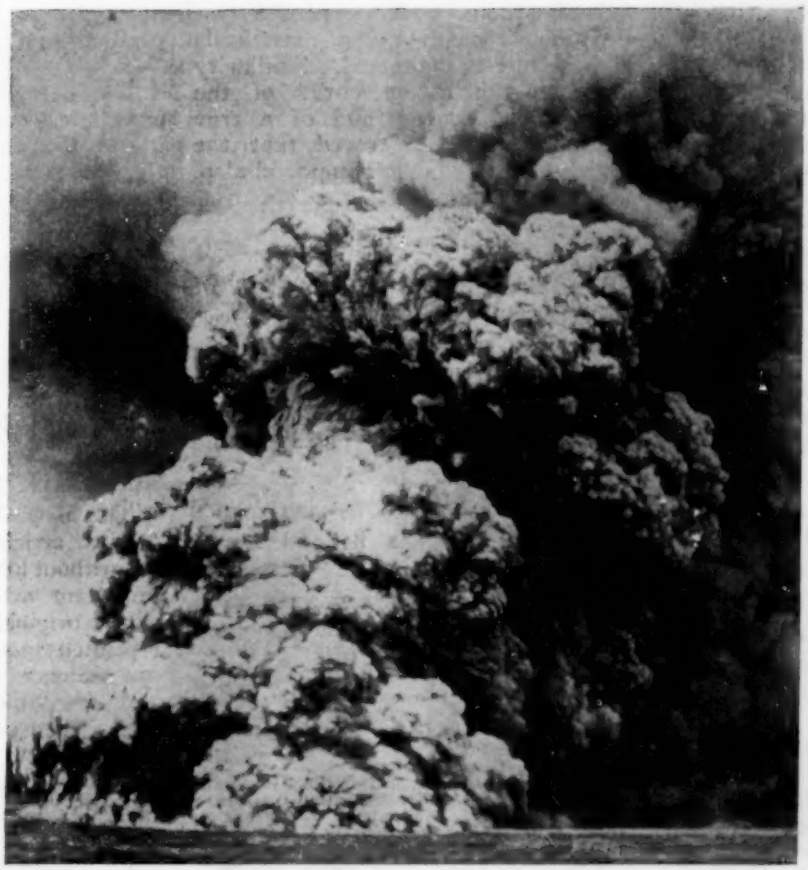

"INTO MAGNIFICENT ERUPTION"

Kilauea Makes Good the Words of a Prophet

(See page 127)

Vol. XV No. 413

German Synthesizes Respiration Ferment

Physiological Chemistry

The respiration ferment, described as ruling the organic world, has been produced artificially in the laboratory by Prof. Hans Fischer of Munich, who has thus made one of the most important contributions in the history of biochemistry, the chemistry of living matter. His achievement is far-reaching and may lead to isolation of the vitamins themselves.

Prof. Fischer's work confirms the research of Dr. Otto Warburg, who last year demonstrated the nature and role of this important ferment. The respiration ferment is a hemin compound and its synthesis makes possible the artificial production of hemoglobin, the red coloring matter of the blood. In the higher animals, hemoglobin is a transport agency for oxygen, carrying it from one place in the body to another. But the respiration ferment is a substance which takes up the atmospheric oxygen, which was transported by the hemoglobin, and transfers it to certain organic substances which in turn become oxidized. The respiration ferment or enzyme rules the organic world, because in everything that happens in living matter, respiration furnishes the driving force. It is found in all living cells.

The synthesis of this compound is a good example of how optical instruments can aid in the solution of biochemical problems. Transmittency measurements, measurements of transmission or absorption of light, assisted in the solution of this problem.

Dr. Warburg, seeking a method to prove whether or not the respiration ferment was a hemin, measured the absorption spectra of a model pigment, hemonicotin, and determined its action curve. He then obtained the action curve of the respiration ferment, using yeast cells in which it is contained. Similarity between the action curve of the respiration ferment and of a true hemin compound showed that the ferment was a hemin compound also.

It is this compound that Prof. Fischer has just synthesized. This respiration ferment may become therapeutically important. It is a question whether it is more or less important than the four pyrrol nuclei with which Prof. Fischer started its synthesis. Hemin and chlorophyl, the green coloring matter of plants, both contain these four pyrrol nuclei. It is possible that the vitamins may be found in these very pyrrol nuclei. In that case, organic chemists even today have vitamins by the ounce in their laboratories and do not even know it.

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Narcosan No Drug Cure

Medicine

Narcosan, alleged cure for drug addiction put forward more than two years ago, has been tried and found wanting by the Mayor's Committee of New York on drug addiction. Studies of the Narcosan treatment have been conducted at the Bellevue Hospital since May, 1928.

"The results reported here show clearly that Narcosan has no merit as a specific treatment of drug addiction," announced the committee in a communication to *The Journal of the American Medical Association.* The Narcosan treatment was given to 68 patients, addicts to morphine and heroin. The conclusions as to the merit of this and other treatments were based on the number and intensity of the withdrawal symptoms.

The occurrence and relative intensity of seven most characteristic symptoms noted when drug addicts are deprived of the drug were studied in 100 control cases. This furnished a basis for comparison with the various specific treatments, of which Narcosan was one. Clear-cut results were obtained. In the Narcosan-treated group greater occurrence and intensity of all seven symptoms were observed.

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The high melting point of tungsten, above 3,000 degrees Centigrade, enables this metal to carry the heavy currents needed in bright illumination.

The first successful descent in a parachute recorded in history was made by the Chinese Emperor Shun, more than 2,200 years before Christ.

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All of the resources of Science Service, with its staff of scientific writers and correspondents in centers of research throughout the world, are utilized in the editing of this magazine.

Kilauea Erupts, Fulfilling Prediction

Volcanology

"Kilauea flashed into magnificent eruption at 1:00 a. m. Hawaii time (6:30 a. m. Eastern Standard Time) this morning."

This radiogram, received in Washington by the U. S. National Park Service on Wednesday, February 20, fulfills in spectacular fashion the prediction of Dr. T. A. Jaggar, of Volcano House, Hawaii, government volcanologist, that an eruption might be expected this year. The prediction was published in the SCIENCE NEWS-LETTER on February 2, and has been made good in less than a month's time by the volcano on whose rim Dr. Jaggar has lived, watching, for more than half a generation. The volcano itself is a ward of the United States government, as it is a part of Hawaii National Park.

Washington specialists in volcano science received the news with great interest.

"It has been a long time since the last major eruption of Kilauea," said Dr. A. L. Day, director of the geophysical laboratory of the Carnegie Institution of Washington. "We all felt that something was due, and even over-due, to happen."

No report of any damage or loss of life was reported in the first news of the eruption, and it was not anticipated that any serious harm will be caused. Kilauea enjoys the reputation of being a spectacular but on the whole well-behaved volcano, whose eruptions are not of the dangerously explosive type such as wiped out Pompeii in the early days of the Christian era, and devastated Martinique less than a generation ago. Such explosions are caused by the penning up of the steam and other gases in the vent, until they reach bursting pressure.

Kilauea has a huge safety valve, known as Halemaumau Pit, in the southwestern end of its huge oval crater, nearly three miles across at its greatest diameter. The constantly boiling lava in this pit gives off vast quantities of steam and hot gases, and vents some of the superfluous energy of the volcano, which might otherwise make Kilauea a menace to all life in Hawaii. Only when the lava on the lake becomes partially "frozen" is there any possibility of explosive eruption.

There are two major eruptions on record which displayed explosive phases. One of these occurred in 1825, when the noted English writer Lord Byron was visiting the islands. He was awed by the thunderous cloud of steam that rose from the volcano and by the great showers of falling stones and ashes.

The other explosive eruption occurred in 1789 and 1790, while the islands were still under the rule of native monarchs. A division of King Keoua's army, bivouacked indiscreetly close to Kilauea, was annihilated. Native eyewitnesses reported that the eruption was preceded by violent earthquake shocks, terrific thunder and lightning, and a dense cloud of darkness that rose from the crater and enveloped the entire region.

But during the past century there has been no eruption of this type. Kileauea is almost ceaselessly active, but its activity consists mainly in the rise and fall of lava within the crater. It seldom overflows the rim, and as a matter of fact does not often climb out of the deeper pit of Halemaumau itself onto the floor of the crater. When the lava does rise high enough to overflow the crater it usually courses quietly down the mountain-side, burning its way through forests and plantations that may happen to lie across its path, but not causing widespread devastation. The same relatively quiet lava flows are characteristic of Kilauea's sister volcano, Mauna Loa. Mauna Loa has a smaller crater than Kilauea, but is more than 10,000 feet higher, reaching an altitude of more than 12,000 feet.

The studies of Dr. Jaggar have shown a periodicity in the activity of both volcanoes. A crisis in the affairs of Mauna Loa comes about every four and one-half years, and Kilauea's lava rises highest at intervals of about nine.

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Dr. Jaggar's Own Story

Volcanology

By T. A. JAGGAR

Lava fountains 200 feet high along a crack on the bottom of Kilauea's most active pit were the most awesome features of the great eruption that began shortly after midnight on the morning of February 20. A crack 1300 feet long runs across the northwestern part of the bottom of Halemaumau Pit, and it is from this that the fiery fountains rushed upward.

A lava lake sixty feet deep, with diameters of 1500 and 1000 feet, has formed, and is rising at the rate of five feet per hour. After twelve hours of eruption, the fiery jets of the fountains rose 100 feet above the surface of this lake. The fountains were casting drops of lava into the air, which fell as they cooled. At first the stony shower consisted of pumice, but now the lava drops are glassy, and there are great quantities of lava needles, and of fine brown wind-spun lava threads known as "Pelé's hair". Pelé was the ancient Hawaiian goddess of the volcano.

The eruption has been accompanied by a display of bright light and a constant rumbling noise. Clouds of blue, sulphurous fumes roll into the air from the pit.

The seismograph at Volcano House shows a continuous volcanic trembling and tilts away from the pit.

Halemaumau Pit, where the present eruption is centered, is Kilauea's usual focus of activity. It is an enormous hole in the southwestern floor of the crater, 3400 by 4000 feet. Landslides of material previously piled up on its slopes are constantly sliding into its depths, and these volcanic avalanches have been going on incessantly since the present eruption started.

It is expected that the eruption will continue for some weeks at least.

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Kilauea on Schedule

Volcanology

Kilauea follows a regular cycle of activity, according to the studies of the late Prof. James D. Dana, one of the first to determine the unique features of the Hawaiian volcanoes. First the liquid lavas rise, filling up the crater and consequently raising its floor. This phase was reported during the past few months, culminating in Dr. T. A. Jaggar's bold but promptly fulfilled forecast of an eruption in 1929.

When the crater has filled there is a discharge of the lava through some conduit down the mountain-side. This is followed by a down-plunge of the crater floor undermined by the discharged material. Then follows another cycle beginning with the rising of the floor, which continues until the augmenting forces, from one source or another, are sufficient for another outbreak.

Science News-Letter, March 2, 1929

"The Urgent Issue of Sex Education"

Modern "realism" insists upon endless discussion of sex. And extremists always treat the subject emotionally, not rationally.

Without solid information we are at the mercy either of the prudish or the prurient. Here are some reliable, unemotional books on various aspects of the most discussed question in history:

***The Hygiene of Sex*:**

Brief, careful; written in plain terms, with scientific exactness. "Can be recommended unreservedly," says *Medical Woman's Journal*. Illustrated. By MAX VON GRUBER. $1.50.

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Oil to Rival Gasoline in Engines

Engineering

By Douglas W. Clephane

Among the unsolved mysteries of the war period is the manner in which Rudolf Diesel, inventor of the heavy oil internal combustion engine, met death. All that is known is that he strangely disappeared from an English channel steamer a few months before the outbreak of the war when the oil engine was undergoing trials for commercial, military and naval uses.

He evidently died with the fear that his engine did not have the tremendous future he had at first believed. It is reported on good authority that both France, the country of his birth, and Germany, where he developed most of his inventions, had turned down plans for the extensive military and naval use of an improved design oil engine. If he could have lived a few more years he would have seen the Diesel engine driving scores of submarines which almost won the war for Germany, and if he were alive today he would see the heavy oil engine rapidly replacing the steam and gasoline engines. Such a revolution is now taking place in the engine industries of the world that this generation may see the day when our motor cars, airplanes, airships, locomotives, power plants as well as the shipping of the world will be driven by Diesel oil engines at a fraction of the present cost.

It was reported that when he disappeared Diesel was going to England to present plans to the British Admiralty which he believed would revolutionize the navy. When the war broke out a few months later both England and Germany charged that the inventor had met with foul play at the hands of the secret service of the other country. Not the slightest evidence was ever uncovered to support such a murder theory, and a most extensive investigation failed to reveal what happened to him after he boarded the steamer. Some say he jumped overboard because of disappointment over failure to have his engine more generally adopted. However, he had amassed a fortune reported to have been over a million dollars from his inventions, and his early work in the oil engine field had been given due recognition by various museums. Additional mystery was added by the fact that his family received a telegram announcing his safe arrival in London—but it was sent from Geneva, Switzerland.

THE U. S. COAST GUARD CUTTER DALLAS, powered with two 150-horsepower Diesel engines, drives through storms that make her a virtual iceberg

Although Diesel did not live to perfect his engine for use in the many fields to which it is now being applied, it is interesting to note that he is one of the few inventors who have obtained entire credit for their early work. All heavy oil engines which inject the fuel into the compressed air and depend on the heat of that compressed air for ignition are known as Diesel engines, and his patents were never successfully questioned.

In the last ten years the Diesel heavy oil engine has rapidly replaced the steam engine in shipping and power plant installations and engineers are finding that it may eventually replace even the gasoline engine in aircraft, motor cars and trucks, and that the possibilities of its extension to other fields are unlimited.

The modern oil engine is generally similar in appearance to an ordinary engine of equal horsepower. They are both internal combustion machines, obtaining their power from the expansion of hot gases from burning fuel. The expanding gases force down the pistons in the cylinders, thus turning the crank shaft. However, the Diesel engine does away with the complicated carburetor and with electric ignition systems. Instead of drawing in a charge of air and gasoline vapor, which the gasoline engine ignites by an electric spark, the Diesel engine sucks in air only on the downstroke which is compressed on the upstroke to one-twelfth or one-fifteenth of its original volume, thus heating the air to such a high temperature by compression that the oil ignites spontaneously on being injected separately.

The greatest advantage of the oil engine over steam and gasoline engines lies in its economy. The most efficient steam engine returns only about 17 per cent. of the potential energy in the fuel in the form of power, while the gasoline engine does not do much better. The modern Diesel engine has a thermal efficiency of 33 per cent., or, in other words, the Diesel engine wastes only 67 per cent. of the fuel, while the steam engine wastes from 83 to 90 per cent. Because low priced oil can be used, the fuel cost is often one-third that of similar gasoline engine and steam installations.

By doing away with the carburetor, ignition, and high explosive fuel, the fire hazard, which is such a dangerous factor in shipping, aircraft and automobiles, is practically eliminated. (*Turn to next page*).

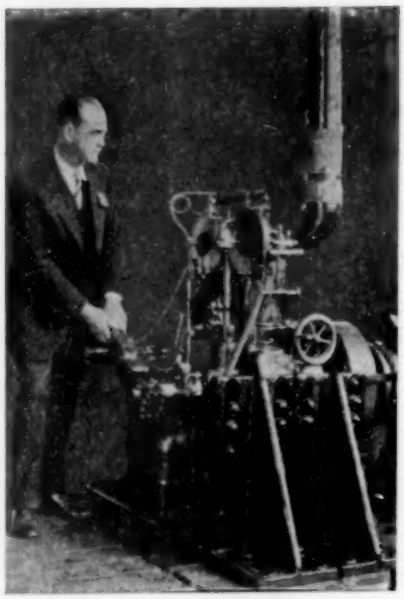
Diesels Compete with Gasoline Engines—*Continued*

As the oil engine operates at high compression all working parts must be more substantially built than in other engines, thus making its weight much more and the first cost higher.

Solutions are being found for practically all the problems of the oil engine, and experiments being conducted by the National Advisory Committee for Aeronautics, the Navy Department, and several engine manufacturers, indicate that the Diesel engine may eventually be the ideal power plant for aircraft and automobiles. The British airship R101, now nearing completion in England, will be the first airship to be equipped with Diesel motors. Five 650 horsepower units are being installed in this ship, and the experiments which have been made on the engines have led the U. S. Navy Department to specify that Diesel engines are to be used on the two new American airships now under construction, if they are available when the ships are completed. At least one American manufacturer is about ready to produce a lightweight power plant for airplanes which will weigh about 3 pounds per horsepower.

As fire is one of the main problems both in airships and airplanes these developments are particularly significant. The heavy oil fuel actually acts as a fire extinguisher for some blazes and will not ordinarily burn under atmospheric conditions. If the oil engine can be successfully adopted to aircraft, which seems merely a question of time, the often repeated story of pilots and passengers cremated alive in the burning wrecks of their airplanes will be a thing of the past. The use of the Diesel engine will also add greatly to the carrying capacity and cruising radius of aircraft, as a tank of oil will give more miles per pound of weight than gasoline, and the fuel economy will reduce the cost per mile of air transportation.

In Europe the oil burning motor car, truck, and motorcycle have ceased to be novelties, and such installations have proved their efficiency for many uses. The adoption by American automobile manufacturers of the Diesel engine will probably be slower as gasoline costs much less in this country, and economy of operation is not such a big factor here as abroad. So far a satisfactory high speed oil engine has not been developed, and the greater first



DIESEL ENGINE FOR AIRPLANES, now being tested experimentally by the National Advisory Committee for Aeronautics

cost will be a drawback to its adoption in the highly competitive low priced car field. However, it has successfully proved its worth in the heavy motor truck and tractor field, where fuel constitutes a large proportion of total operation costs. As most of the troubles from gasoline engines come from the carburetor and ignition systems the elimination of these devices will be a big factor in favor of the future adoption of the oil engine to the motor car use. It is reported that at least six large factories in Europe are engaged exclusively in producing oil engines for automobiles and trucks, and many automobile companies in this country are known to be conducting experiments along this line.

Practically every traveler on American railroads has protested at one time or another against the smoke of locomotives, and this is believed to be one of the reasons for the increasing preference for motor bus and motor car travel. Several long stretches of railroad have been electrified, thus doing away with smoke and lowering operation costs. Several of the largest American railroads plan to eventually electrify all their main lines. However the success of the first large Diesel electric locomotives on these lines has caused railroad executives to ask if this type engine may not eventually furnish the main railroad locomotive power. Not only does this locomotive do away with the smoke nuisance, but it can be operated much more economically than the traditional steam engine. The engineer can devote his whole attention to the road ahead instead of having to watch a multitude of gauges. Although the Diesel electric engine costs nearly twice as much as the steam locomotive, its greater economy, its long running time without overhaul being necessary, and the abatement of the smoke nuisance, are believed to be factors which will make it rapidly replace the steam engine on long hauls and for switching use.

Many railroads, especially those in Europe, are adopting either the direct drive Diesel, or the Diesel electric-drive railway single car, for branch lines where the traffic does not warrant the use of an engine. These cars have met with such success and popularity that many branch lines that constantly showed a loss with steam operation are now operating at a profit, allowing increased service to small communities.

The greatest application of the Diesel engine has been to merchant shipping. Diesel lived to see the first ship equipped with oil engines in 1910 but success was not assured at the time of his death in 1913. In 1927 over one-half of the shipping under construction was to be equipped with Diesel engines, and this does not take into account the large number of ships which were being converted to Diesel drive. The U. S. Shipping Board alone has spent in the last four years or has contracted for Diesel electric or direct Diesel drive installations totaling $25,000,000. Five years ago many ships were installing oil burning equipment under their steam boilers without using Diesel engines, but today the majority of such conversions are to the Diesel drive. These installations are of two types, first, the direct drive, in which the oil engine turns the propellers directly, and second, the Diesel-electric, in which the Diesel engines drive generators. These in turn furnish power to electric motors which drive the propellers. In ships of this type the motor controls are often carried directly to the bridge, allowing the captain to control the speed of his vessel without the necessity of signalling the engine room.

A. C. Hardy, one of America's leading Naval architects, recently said: "The Diesel equipped ship's fuel bill is (*Turn to next page*)

Gnats Threatening Sight of Children

Entomology

Fifteen hundred children in the Coachella Valley Union High School at Thermal, California, suffering with serious conjunctivitis, or pink eye, due to the ravages of the California eye gnat, have caused the House Appropriations Committee to insert an item of $12,000 in the Second Deficiency Bill for the purpose of allowing experts from the U. S. Bureau of Entomology to go out there to see if they can destroy this pest.

A letter to Dr. C. L. Marlatt, chief of the Bureau of Entomology, from E. P. Carr, president of the Coachella Valley Mosquito Abatement District, was read into the record, according to hearings before the committee, just issued.

The gnat, known scientifically as *Hippelates pujio,* is said to have increased to an alarming extent in the Coachella Valley in the last five years.

It hovers in swarms about the eyes, noses and mouths of persons and stock. Small children are especially helpless against it. Over one-half the school children in this region now have serious eye trouble caused by the gnat, and ten per cent. of them have contracted chronic trachoma.

The district and the State of California have both done all that they can do, but have not been able to locate the breeding places of the gnat. The president of the district declared:

"Basic and preliminary scientific problems of life history must be worked out, we believe. Such pioneer research work is of national importance and is more than our local organization can compass."

Representative Phil D. Swing, Republican, of California, has declared in a statement to the committee that these were no ordinary gnats. "My people are a hardy, sturdy type of pioneers and are able to resist any ordinary inconvenience such as would come from ordinary flies, gnats, or mosquitoes," he said. "This thing is entirely new. The belief exists that these gnats came from some foreign country through the importation of date palms. Unless it is controlled it will render that part of the country uninhabitable."

Common house flies, according to Dr. Marlatt, act in Egypt somewhat in the manner of this Coachella Valley gnat. They will swarm about the eyes, causing all sorts of eye troubles.

Florida is also having some trouble with eye gnats, he said.

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Diesel Engines—*Cont'd*

roughly a third of that of the steamship, and the advantage is cumulative, extending into every phase of the ship's operation."

Not only does the oil engine reduce the fuel bill, but it greatly reduces the number of men required in the engine room. In ships of this type the stoker sweating in the bowels of the ship in a stoke hole, with the temperature often well over 100 degrees, is a thing of the past. Possibly the greatest advantage of such ships is the amount of coal bunker space which the oil engine releases for cargo or commodious passenger quarters. In large ships the fuel takes less than a third of the space which coal would require to obtain an equal cruising radius.

Developments in the marine field indicate that the familiar letters S. S. before the name of a ship, indicating steamship, will be eliminated, as the Diesel engine has proved its greater efficiency for practically every type of ship from the small yacht to the largest ocean liner, and the steam boiler is rapidly becoming an obsolete installation.

While the use of the oil engine in land and air transportation is still in its infancy, the stationary oil engine has secured practically a monopoly for pumping on long pipe lines, and its use for large power plants is rapidly increasing. There seems to be no field in which theoretically the oil engine cannot be used more efficiently than (*Turn to next page*)

League of Nations to Broadcast

Radio

Broadcasts by short wave radio of speeches from the League of Nations, especially for the American continent, Japan and Australasia, will be sent out from Holland next month. This announcement was made by the Federal Radio Commission, following the receipt of a communication from the Secretariat of the League at Geneva. Telephone lines will carry the words of the speakers from Geneva, Switzerland, to Kootwijk, Holland, where a powerful short-wave station is operated by the Dutch Postoffice. It has the call letters PCLL, and uses wavelengths of 18.4 and 38.8 meters.

While the broadcast will be of an experimental nature, it is believed if the reception is at all clear a regular broadcasting program will be worked out. International broadcasting is difficult because of the different languages of the radio audiences. The experiments of the League of Nations in March will attempt to reach certain sections of the world where reception conditions are good. A particular effort will be made to reach audiences in North and South America, Japan, Australia and New Zealand with programs given in the language of each country.

The League of Nations has already conducted certain experiments along this line, and reports have been received from 92 listeners in five different continents. These first experiments were mainly for the purpose of receiving technical reports from professional radio operators, but many individuals reported that the reception was entirely clear from their loud speakers. The broadcast in March will be the first attempt to reach particular regions with special programs.

The schedule as announced is as follows: to the American continent, March 12, 19, and 26, one hour, from 5 to 6 p. m., in English, French and Spanish, on a wave length of 38.8 meters; to Japan in Japanese every Wednesday, March 13, 20 and 27, 30 minutes from approximately 8:40 to 9:10 p. m., on a wave length of 18.4 meters; to Australia in English March 14, 21 and 28, 30 minutes on the same wave length, and at about the same time.

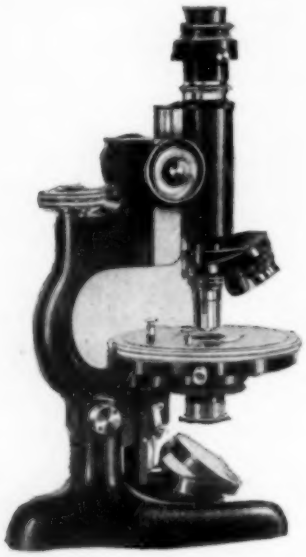
The Secretariat of the League of Nations said that while these broadcasts were purely of an experimental nature, it was quite possible that regular programs would be broadcast internationally if the reception of these first programs in March is clear.

Science News-Letter, March 2, 1929

An expert says that in many workshops the natural light is cut down one-fourth by dirty window panes.

Pennsylvania is the only state with a mineral production worth more than a billion dollars a year.

The Chemist's Right-Hand Man



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An old Persian belief held that an agate has power to stop a storm.

In years of famine more than one-fourth of the Labrador Indians have been wiped out.

Diesel Engines—*Cont'd*

steam or gasoline engine installations. The greater first cost of such engines is warranted only where the fuel bill constitutes a large proportion of operation costs or where the greater flexibility, safety, and other factors offset the first cost. New manufacturing process and improvements in design now being developed are reducing the cost to a point where the general application of the Diesel oil engine to aircraft, automobiles, locomotives, and other fields is believed to be only a question of time.

It is often said that it will be only a few score years before the petroleum and consequently the oil and gasoline resources of the world will be exhausted. The Federal Oil Conservation Board appointed by President Coolidge in 1924 seems to have exploded this estimate, but there is no question that the free flowing oil is being depleted more rapidly than new fields are being found. The Board reports: "The adequacy of the supply of oil shale as raw material for the extraction of oil is now beyond question. A conservative estimate of the amount of petroleum that can be extracted from the known oil sands is 92,000,000,000 barrels or ten times the total quantity of oil that has been produced in the United States to date."

Assume that the oil supply will fail in the future. Diesel engines will still run. For they will operate on nearly any liquid fuel. And synthetic oil can now be made from coal and lignite.

Human Eye More Acute Than Bee's

Optics—Physics

The first scientific determination of the acuteness of vision of a bee is but one of the interesting topics described at the recent joint meeting at Columbia University, New York City, of the Optical Society of America and the American Physical Society, and reported below.

The eye of a bee is not nearly such a wonderful organ of sight as many romantic naturalizers would have us believe. It is, in fact, only about one per cent. as good as the eye of a human being when it comes to distinguishing separate objects and the distances between them. At the joint meeting of the American Physical Society and the Optical Society of America, Prof. Selig Hecht and Dr. Ernst Wolf, of Columbia University, told of experiments which established the degree of visual acuity of the bee.

They let bees walk up a sloping glass plate, beneath which was a moving slide with alternating dark and bright bands, giving a sort of picket-fence effect. The bee would change the direction of its march when it saw the bright bands moving, and it paid no attention to bands that were too narrow for it to see. By using a number of slides, with varying widths of bands, it was possible to find the narrowest object which a bee can perceive. This was found to be a hundred times as wide as the narrowest object a human being could perceive at the same angular distance.

Bee and human eyes were found to be alike in that both see badly in a dim light and better in a bright one. Above a certain degree of brightness, however, no improvement in sharpness of vision could be discovered.

Winter Lacks Ultra Violet

Winter sunlight is not only less intense than that of summer, but contains less of the sun-burning ultraviolet waves, Dr. Arthur D. Riddle of the Hegeman Memorial Research Laboratory announced.

Sunburn and the other biological effects of ultraviolet rays are produced by a certain band of wavelengths, not longer than 1/78,000 inch and not shorter than 1/86,000 inch, approximately. As the length of the shortest waves in sunlight is some place between these figures, Dr. Riddle made measurements of the limit at different times of the year, on both clear and cloudy days.

His results show that June sunlight, in both clear and cloudy weather, contains shorter waves than even clear December weather. In June, on both clear and cloudy days, waves as short as 1/84,300 inch were present. On a clear December day, the shortest were 1/82,300 inch, while on a dull day no waves shorter than 1/81,800 inch were detected.

New Cell May Aid Television

A new form of photoelectric cell, for converting light waves to electric impulses, using the metal caesium, instead of potassium, may prove of value in television because its response is more similar to that of the human eye. The new cell was described by V. Zworykin and E. D. Wilson, of th Westinghouse Electric and Manufacturing Co.

It has been known for some time that caesium offers a number of advantages for use in photoelectric cells, said Mr. Zworykin. The difficulties of handling pre- (*Turn to next page*)

First-Born Are Problems

Orthopsychiatry

The first-born child in a small family is more apt than any of his brothers and sisters to have such emotional and mental difficulties as to put him in the class of problem children. At least such children present problems to child guidance clinics more frequently than other children from small families, reported Dr. Curt Rosenow of the New York Institute for Child Guidance to the meeting of the American Orthopsychiatric Association.

Dr. Rosenow has made an extensive statistical study of the children coming to child guidance clinics in Cleveland and Philadelphia, from which he draws the above fact. As far as second and third children of small families are concerned, the figures did not permit any very definite conclusions, said Dr. Rosenow.

Possibly the fact that the oldest child has arrived first at an age when mental and emotional problems might develop is a factor in the more frequent appearance of these children at the clinics. Certainly younger children are born into a situation typically different from the one into which the first born is introduced. This must be taken into consideration. However, nothing can be concluded on the basis of primogeniture alone, Dr. Rosenow declared.

Science News-Letter, March 2, 1929

Future Metal Supply Doubtful

Metallurgy

The world's metal supplies in the rocks of the earth are showing signs of failing and experts are worried over whether the most efficient applications of science and technology can keep pace with the demands of coming generations. This state of low supplies in the mineral cupboards of the future was revealed to the meeting of the American Institute of Mining and Metallurgical Engineers in New York, when D. F. Hewett, geologist of the U. S. Geological Survey, discussed the production of metals in Europe during the last 300 years.

The European trend toward cartels and understandings to control such metals as iron and steel, mercury, aluminum, zinc, lead and copper, has arisen from the unspoken realization that Europe's metal production has taken a downward tendency, Mr. Hewett said.

In America vast resources of iron, copper, lead, zinc, silver, and gold have been attacked so vigorously that many leading districts are approaching exhaustion, and metal production is being maintained by the application of new metallurgical processes to lower grade ores. American mining operations are deepening shafts at a rate two to four times as fast as those of Europe, Mr. Hewett observed. Whereas mines in Europe range from 1200 to 1600 feet in depth, American mines are often in excess of 4000 feet.

If we are willing to pay the price in fuel, power, and labor, enough iron, manganese, aluminum, and gold can be produced, Mr. Hewett indicated, but mercury, lead and chromium are more localized and less likely to be produced in sufficient quantities for future generations even if the price is increased to stimulate the supply.

Science News-Letter, March 2, 1929

T. B. Takes Two Years

Medicine

Every white baby boy born in this country could expect to live to 57.3 years if tuberculosis were eradicated, and the country would be saved a loss of $179,000,000. This sum is the annual monetary loss due to deaths from tuberculosis, estimated Harold D. Larsen of the University of Wisconsin.

The loss in life expectation is 1.93 years for every white male at birth.

Science News-Letter, March 2, 1929

Human Eye More Acute Than Bee's—*Continued*

vented its use. With the aid of his colleague, he has overcome these difficulties by combining the caesium with magnesium. The magnesium binds the invisible caesium layer to the wall of the glass bulb, and also an electrical connection with it.

Its sensitivity is higher than that of other cells. Also, the color to which it is most sensitive comes very close to that to which the eye best responds. The eye is most sensitive to yellow light. So is pure casesium. The caesium-magnesium, as used in the new cell, responds best to bluish-green light, while the ordinary potassium cell responds best to deep blue. The use of such a cell as the new one in television would give an image with color values closely approaching those of the eye.

Wax Man With Metal Ears

A life-sized, man-shaped dummy, with a wax head and ears consisting of radio head receivers imbedded in the wax at the place of the eardrum, was the apparatus used by F. A. Firestone and D. L. Rich of the University of Michigan in recent experiments.

A loud speaker unit connected to a pipe was set flush with the roof of a building on which the experiments were made. The dummy was arranged so that it could be turned to any position or distance with respect to the sound, or any distance from it. Sound waves vibrating the diaphragms of the phones caused an electric current, which they measured. As a result, they announced, they found that the actual measurements were very close to others that had been calculated theoretically on the basis that the head is a rigid sphere in free space.

Stereoscopic Movies Possible

Stereoscopic motion pictures, that seem to possess depth from any position, and not requiring any special viewing apparatus between the subject and the screen, were described by Dr. Herbert E. Ives, of the Bell Telephone Laboratories. However, he emphasized that the apparatus for taking and projecting them is complicated and costly.

The method makes use of a principle for obtaining still stereoscopic pictures that he described before the meeting of the Optical Society last year. The screen consists of translucent material. Just in front of it, and just behind it, are vertical gratings with wide opaque strips separated by much narrower transparent areas. A large number of motion-picture machines project onto the screen from a number of films that were made with a large number of cameras on all sides of the subject.

The result is that no matter where a person sits, so long as he is in front of the screen, he sees the picture in relief. Because of the gratings, one eye sees a picture made with one camera, and the other the next, made with another camera. This gives the stereoscopic effect, and as the observer moves from one side to the other he sees what appears to be a solid object.

Science News-Letter, March 2, 1929

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In a Blind Alley

Evolution

WILLIAM CROWDER, in a Naturalist at the Seashore (*Century*):

There is one group, or phylum, of marine animals, however, of which since the time of its most ancient day no record has been traced. It was ancestral to no land form, living or extinct. The echinoderms, to which our serpent-star belongs, have not now, and never have had, any relatives near or remote living away from the sea. In this isolation they are unique. Nature seems somehow long ago to have abandoned all effort to lift them to a higher plane; the modern representatives appear not to be greatly altered in form during these millions of years since their ancestors turned to stone.

That they have changed since those days is inevitable, but they have nowhere given rise to higher and more specialized forms, such as are to be found among the other groups. Their evolutionary progression has been slow; and if we cite the sea-cucumber as an example, which is wormlike in even more ways than its appearance would imply, this is one instance in which it seems there has taken place actual regression.

Science News-Letter, March 2, 1929

Flashing lights, electrically operated, for lighthouses were first proposed in France, in 1882.

A professor of dentistry at the University of California is straightening the teeth of twelve monkeys.

Venus, Brightest, Casts Visible Shadow

Astronomy

By James Stokley

Shadows cast by the sun during the day are familiar to everybody. So are shadows cast by the moon when it is bright. And with the mention of these, most people would probably think that the list of heavenly objects producing visible shadows would be exhausted. But during this month, it is possible to see shadows cast by a third body—the planet Venus. Before March 10, the moon will set well before Venus, and the evenings will be dark. On one of these evenings get away from the bright lights of the city to a place where you can see the planet Venus, shining more brilliantly than any other star or planet, in the western sky. Then, if you hold up a piece of white paper, and move your hand around, you will be able to see its shadow, cast by the light of Venus.

This month Venus is of the minus 4.3 magnitude, as astronomers reckon the brightness of stars. The negative quantity — with the "minus" in front of it—is due to the fact that accurate measurements of stellar brightness are rather recent achievements. The ancient astronomers Hipparchus and Ptolemy started to measure star brightnesses. They arbitrarily divided all the stars into six magnitudes. The first included the brightest, like Sirius, the sixth the faintest visible to the eye. As this was long before the invention of the telescope, they did not know that there were still fainter stars, and thought that they had taken care of everything.

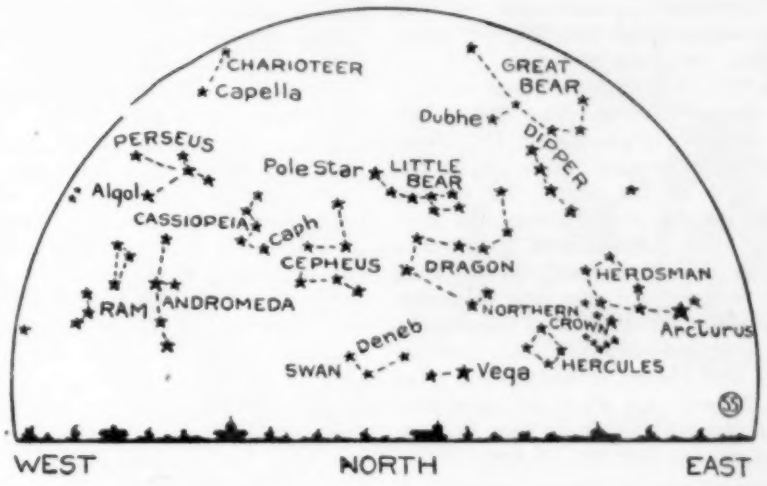
Then came the invention of the telescope in the 17th century. Fainter stars were seen, and as the system had come into such general use, it was extended to the seventh, eighth, ninth, and fainter magnitudes. Today, with the 100-inch Mount Wilson telescope, stars as faint as the twenty-first magnitude can be recorded on the photographic plates.

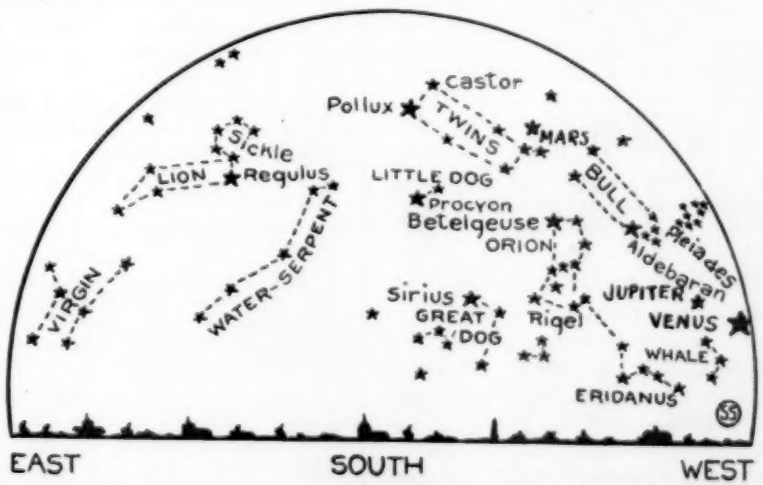
As a definite meaning came to be given the magnitude figures, made possible because of instruments that were able to give precise values of the star's brightnesses, it was found that some of the stars, such as Sirius, were actually brighter than the first magnitude. As the planets become still brighter, it was necessary to use negative quantities. A star of 0 magnitude would be as much brighter than one of first magniture as a first magnitude star would exceed one of the second magnitude. There would be the same difference between a star of minus 1 magnitude and 0 magnitude. The brightest star, Sirius, is of the minus 1.6 magnitude, so that when we say Venus' magnitude is now minus 4.3, we mean that it is very brilliant. On the same scale the full moon would be minus 12.5 magnitude, while the sun would be minus 26.7.

The stars remain at the same brightness unless they belong to the rather large class of variable stars. Why is it, then. that Venus, a few months ago entirely invisible, is now so bright as to exceed almost everything else in the sky? The reason is found in its motion, and the fact that, being a planet, and not a star, it shines with reflected sunlight.

The orbit of Venus is within that of the earth. Once in about 225 days it makes a complete circuit of its orbit, so that twice in this period is it visible to earth-dwellers—once as a morning star and once, as now, as an evening star. At one time it is to the east of the sun. Then the sun sets first and we see it in the evening after sunset. After that it moves around and comes between the earth and the sun, as it will do in a few months, and then it is lost in the brilliant glare. After that it moves on to the western side of the sun, and can be seen in the morning, for it rises before the sun. Still later, it moves around to a position back of the sun, and is again completely invisible. Then it again reaches the eastern side of the sun, and, 225 days after the first mentioned position, is again an evening star.

On the average, the earth is about 93,000,000 miles from the sun, while Venus is about 67,000,000. Hence, when it is be- (*Turn to next page*)





THESE MAPS show the sky as it appears these March evenings. Just hold them in front of you as you face north or south, and the upper or lower will represent the stars you see on a clear night

Venus Now Casts Visible Shadow—*Continued*

tween the sun and earth, it is only 26,000,000 miles from us, while when it is on the opposite side of the sun, a distance of 160,000,000 miles separates the two planets. The result is that sometimes Venus is seen much larger than at other times, because it is so much closer. But there is another difference. When it is far away, and on the other side of the sun, we see the entire illuminated surface of the planet, and through a telescope it looks round. When it is at the side of the sun, the telescope shows it larger, but as a semicircle, or a little half-moon. And then as it gets still closer, it becomes a crescent. When just about to disappear in the sun's glare, it is seen largest, and as a very narrow crescent.

These phases of Venus are not apparent to the naked eye, though a small telescope will reveal them. But the brightness that the planet has to the naked eye depends on the area of the illuminated surface that we can see. When it is largest, it is a very narrow crescent, and so the entire illuminated area is small. When it is a somewhat wider crescent, about the same as the moon a few days after it is new, the illuminated area presented is greatest, and then the planet reaches its greatest magnitude. This takes place this month on the fourteenth.

However, even this is not the whole story, for some maxima are more brilliant than others. The planets all travel in a path called the ecliptic. Positions in the heavens are measured from the celestial equator, just as latitude on the earth is measured from the terrestrial equator. The celestial equator is the part of the sky directly over the equator of the earth. The ecliptic is inclined to the equator at an angle of 23½ degrees, which means that when a planet is in one part, it is well to the north, but when it is in the opposite part of the sky, it is equally far to the south. It happens that when Venus, or any planet, is seen in the western evening sky in springtime, it is in the northernmost part of the ecliptic. This, in turn, brings the planet much higher in the sky than it can be in the evening at any other part of the year, and the higher a heavenly object is, the less of its light is absorbed by the earth's atmosphere. So, this month, conditions are just right for making Venus appear just about as bright as it can become.

Though Venus is the most brilliant planet in the sky, it is not the only one. Jupiter runs a close second, and can be seen a little to the east of Venus, of the minus 1.7 magnitude. Except for Venus, Jupiter is brighter than any other star or planet. Still farther east, in the constellation of the twins, Gemini, is Mars, the red planet. Compared with its two planetary brethren, Mars is quite faint, though at that, it is brighter than most of the stars. It diminishes in brightness during the month. At the beginning it is of the .4 magnitude, about the same as that of the star Procyon, in the little dog, which appears in the southern sky. By the end of March it will have faded to magnitude 1, somewhat fainter than the star Betelgeuse, northernmost star in Orion, but brighter than Aldebaran, the red star in Taurus, the bull, seen in the western sky. Owing to the different character of the steady light of the planet, and the scintillant brilliance of the stars, it is rather difficult to compare them with the naked eye, however.

On the evening of the thirteenth the display of brilliant planets in the western sky will be augmented by the moon, for on that date Venus and the moon are in conjunction, which means that they are close together. A few days later, on the eighteenth, the moon occults Mars by passing in front of that planet, but as the occultation occurs in the morning, after sunrise, it will not be seen with the naked eye.

The evening sky this month presents ten stars that are brighter than magnitude 1.5, commonly called "first magnitude" stars. These include Sirius, in Canis Major, the great dog, low in the southwest; Capella, in Auriga, the Charioteer, in the west, a little to the north; and Arcturus, in Bootes, low in the east. Rigel, the lower star in Orion, and Betelgeuse, the northern one, already mentioned, also belong in this group. So does Procyon and Aldebaran, Pollux, the southernmost of the twins, Gemini, high in the west; Spica, in Virgo, in the southeast; and Regulus, the bright star at the end of the handle of the "sickle" in Leo, the lion, hanging like a question mark in the south.

Science News-Letter, March 2, 1929

According to available records, there were just 44 Americans in China in 1836.

A careful census of the Navajo tribe, now being taken, indicates that there are about 38,000 of these Indians.

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First Glances at New Books

PHYSICS OF THE AIR—W. J. Humphreys—*McGraw Hill* ($6). Since 1920, when the first edition of Physics of the Air came out, the activities of the atmosphere have assumed increased importance in our daily lives. Weather reporting and forecasting have become more and more transoceanic matters, aviation has passed from a military to a commercial basis, the outdoor range of sound has become something of practical importance. For these and many other reasons, this new edition of Prof. Humphreys' book, thoroughly revised to date and including much new material, will receive a double welcome: as the return to availability of an out-of-print classic, and as the incorporation into a single volume of the most modern fundamental knowledge in an important though too little exploited branch of the science of physics.

Meteorology
Science News-Letter, March 2, 1929

DIABETIC SURGERY—Leland S. McKittrick and Howard F. Root—*Lea and Febiger* ($4.25). An important contribution to the literature of surgery is this volume which reviews in detail the work at the New England Deaconess Hospital "during the first five years of the Banting era." Dr. Daniel F. Jones and Dr. Elliott P. Joslin add forewords. The book is well and profusely illustrated.

Medicine
Science News-Letter, March 2, 1929

DIABETES AND ITS TREATMENT—Frederick M. Allen—*Funk & Wagnalls* (30c). Facts about the symptoms, causes, treatment and general care of diabetes which will be helpful to those suffering from the disease or to their families. The little book is another of the National Health Series.

Hygiene
Science News-Letter, March 2, 1929

BACTERIOLOGY AND SANITARY SCIENCE—Louis P. Gershenfeld—*Lea and Febiger* ($4). The book is designed for students in pharmacy, chemistry, nursing and allied sciences. As such it does not pretend to give complete details of bacteriology, parasitology, etc., but only such details as will be of practical help to the persons for whom it was written.

Bacteriology—Public Health
Science News-Letter, March 2, 1929

THE RADIO LIBRARY: Vol. I, Radio Fundamentals; Vol. II, Radio Tubes and Antennas; Vol. III, Radio Transmitters and Carrier Currents; Vol. IV, Radio Receivers and Servicing; Vol. V, Radio Measurements.—*International Textbook Co.* ($7.50). In these five little books, each small enough to go into a coat pocket, is contained a complete and concise library of information on all phases of radio. The radio dealer, the service man, the "ham" or even the ordinary broadcast listener who wants to know some of the technical details of radio, will find the work of interest. Good printing and binding add to its value.

Radio
Science News-Letter, March 2, 1929

MOTHERHOOD IN BONDAGE—Margaret Sanger—*Brentano's* ($3). Miss Sanger's book is chiefly a collection of the letters sent her by desperate women seeking a way out of their bondage of too much motherhood. The author has wisely written only a few paragraphs at the head of each chapter, letting the mothers tell their own tragic tale of too early and too many children, complicated by sickness and poverty.

Eugenics
Science News-Letter, March 2, 1929

ELEMENTARY EUGENICS—Elliot R. Downing—*University of Chicago Press* ($1.75). This book, besides explaining the laws of heredity, makes a plea for the application of eugenic principles to the breeding of men as well as of race horses, fancy poultry and plants.

Eugenics
Science News-Letter, March 2, 1929

NATURE CRUISINGS—John Van Schaick—*Murray* ($2.50). The personal reminiscences and observations of a person in tune with the objectives of science.

Natural History
Science News-Letter, March 2, 1929

A REVISION OF THE NORTH AMERICAN SPECIES OF BUPRESTID BEETLES BELONGING TO THE GENUS AGRILUS—W. S. Fisher—*Government Printing Office* (65c). This is Bulletin 145 of the U. S. National Museum; of interest to students of entomological taxonomy.

Entomology
Science News-Letter, March 2, 1929

NATURE RAMBLINGS
By FRANK THONE

Natural History

Sea Citizens

When the virago wife of the comic strip tells her hen-pecked spouse to "shut up", we do not expect the poor, persecuted husband to maintain silence longer than that day's installment of fun. He has to say something at the beginning of the next day's strip, if only to start things moving.

The gaff-topsail catfish of South Atlantic regions, however, has a real burden of "jaw-holding" imposed upon him. Seventy days is his minimum sentence for that is the length of time it takes for a batch of his wife's eggs to hatch out, and he has to keep them in his mouth until they do. Even after they are out of their little vellum shells his sentence is not quite up, for they have to remain in daddy's sheltering jaws until they are able to swim for themselves, and even after they leave the parental roof-of-the-mouth, he swims about with them for a time, ready to receive them back into the fold if danger threatens.

During all this time he cannot eat, for if he should attempt to he might swallow some of his own offspring, like Chronos of old; he has no special pouch or cavity to carry the eggs in. Plenty of water, but no bread, is included in his seventy days' sentence. Only when the youngsters are able to shift for themselves can the devoted parent depart and seek a meal of soft-shelled crabs.

Such solicitude on the part of either parent is not frequently found among fishes. The usual stunt is to produce a large quantity of tiny eggs and allow for an extremely heavy infant mortality. Indeed, there are many fish that will eat their own offspring without any sign of conscience. But the gaff-topsail catfish produces only a few relatively large eggs—one or two dozen as a rule—and must therefore take better care of them.

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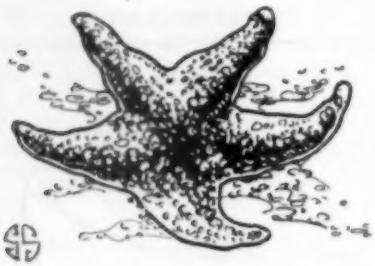
Nature Ramblings—*Cont'd*



Starfish

They are such dead, dry, rigid things as one finds them in museums and curio shops, that it is hard to believe that they ever were alive, or to imagine what kind of life could have been in such a creature, so utterly different in shape and construction from "flesh, or fowl, or good red herring", from worm, or bug, or snail, or anything else alive that we are commonly used to.

But very much alive the starfish is, when he inhabits the shallow waters of his native shore—he inhabits the downhill, or wet side, of the shore, of course. A living starfish is not stiff, but can bend his five arms under him very completely, and also move them from side to side a good deal. His movements are not very swift, but there is no need for haste in most cases, for the food he is after is even slower than he.

The starfish feeds very largely on small sea creatures like shell-fish. He has a very strong liking for oysters. It worries him not at all that he cannot pull an oyster's shell open. He simply wraps himself around it, and waits. Presently the poor oyster, suffocated, opens his own shell, and the giant outside the door engulfs him. The starfish has the interesting and pleasant ability of sticking his stomach outside his mouth, if he finds a bit of food so large he cannot get it through his mouth into his stomach.

Oystermen hate starfish with the holy hatred born of serious financial losses, especially when the five-armed gluttons invade their expensive "seeded" oyster-beds. Latterly an oystermen's association has placed a bounty on their heads—if a starfish has a head. At any rate they want the starfish exterminated, and are willing to pay for the job.

Science News-Letter, March 2, 1929

The great meteorite which fell in Siberia in 1908 scorched the vegetation for miles around.

First Glances at New Books—*Continued*

WHAT EVERYONE SHOULD KNOW ABOUT EYES—F. Park Lewis—*Funk & Wagnalls* ($.30). The vice-president of the National Society for the Prevention of Blindness discusses eyesight for the benefit of the layman. A book from the National Health Series.

Hygiene
Science News-Letter, March 2, 1929

CARE OF THE MOUTH AND TEETH—Harvey J. Burkhart—*Funk & Wagnalls* (30c). The subject is simply explained by the director of the Rochester Dental Dispensary. Another of the useful National Health Series.

Hygiene
Science News-Letter, March 2, 1929

DIE GESCHLECHTSCHROMOSOMEN—Franz Schrader—*Bornstraeger* ($5). The text of this work is in English, though printed in Berlin. It is the first number of a series to be issued under the general title *Zellen-und Befruchtungslehre in Einzeldarstellungen,* edited by Prof. P. Buchner of Breslau. This book is a comprehensive and critical review of the present knowledge of sex chromosomes and will be of great value for reference. An 18-page bibliography adds to its helpfulness.

Biology
Science News-Letter, March 2, 1929

COLLECTED REPRINTS—University of California. This is the eleventh volume of reprints of the reports of work done under the George Williams Foundation for Medical Research. Fifty-one reprints covering a great variety of subjects are included.

Medicine
Science News-Letter, March 2, 1929

COLLEGE CHEMISTRY—Lyman C. Newell—*Heath.* This is the latest edition of a new textbook of chemistry for college students. The author is Professor of Chemistry at Boston University.

Chemistry
Science News-Letter, March 2, 1929

THE BEGINNINGS OF CHEMISTRY—Harriet Blaine Beale—*Coward McCann* ($2.50). Chemistry told to very young chemists. It is up-to-date chemistry, too, and the telling is done brightly, and the pictures will show boys and girls how to do it themselves.

Chemistry
Science News-Letter, March 2, 1929

"MICAL REACTIONS AND THEIR EQUATIONS—Ingo W. D. Hackh—*Blakiston* ($1.75). The second edition of a very useful book intended as a guide to chemical students in learning to balance chemical equations.

Chemistry
Science News-Letter, March 2, 1929

MINDANAO AND THE SULU ARCHIPELAGO, with MAP AND CHARTS OF MINDANAO AND THE SULU ARCHIPELAGO—P. J. Webster—*Bureau of Printing, Manila.* A brief but illuminating description of the geography and economic resources of the largest island of the Southern Philippines, and the second largest of the entire archipelago.

Geography
Science News-Letter, March 2, 1929

THE SPRING AND SUMMER ACTIVITIES OF THE DUSKY SKUNK IN CAPTIVITY—W. T. Shaw—*N. Y. State Mus. Handbook* 4 (30c.). The detailed journal of the development of a young skunk from birth to the fifteenth week will be of especial interest to naturalists.

Mammalogy
Science News-Letter, March 2, 1929

THE ECOLOGY AND ECONOMICS OF ONEIDA LAKE FISH—C. C. Adams—*Roosevelt Wild Life Forest Exp. Sta.* ($2.50). A detailed and exhaustive discussion of the fishes of one of the best known and most important of fresh-water lakes, well illustrated and supplied with a good bibliography.

Ichthyology
Science News-Letter, March 2, 1929

OUR ENVIRONMENT: HOW WE ADAPT OURSELVES TO IT—H. A. Carpenter and G. C. Wood—*Allyn and Bacon* ($1.20). A clearly written, excellently illustrated textbook for a general science course in the junior high school.

General Science
Science News-Letter, March 2, 1929

PHYSIQUE OF WOMEN IN INDUSTRY—Industrial Fatigue Research Board—*His Majesty's Stationery Office.* E. P. Cathcart, E. M. Bedale, C. Blair, K. Macleod, E. Weatherhead and Sybil G. Overton, medical inspector of factories, are the joint authors of this careful report which is issued as "a contribution towards the determination of the optimum load." The study reported was evidently made in thorough and careful fashion and should be of value to those in this country who are interested in various phases of industrial hygiene and woman labor.

Industrial Hygiene
Science News-Letter, March 2, 1929

CLASSICS OF SCIENCE: Hoover on Ore Deposits

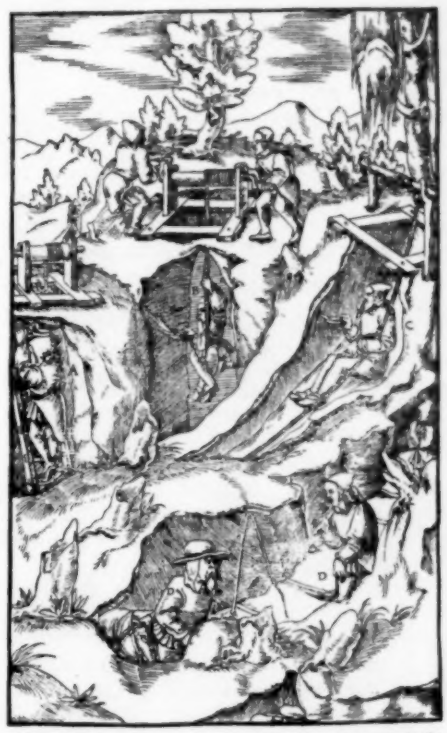
Geology

The translation of Agricola's *De Re Metallica* by President-elect and Mrs. Hoover is doubly a classic of science. The original was one of the great steps in the development of practical geology, but, because it was written in Latin full of technical terms coined by the author, it would have been lost to the present-day world had it not been for the collaboration of the translators. Their scholarship combined with their scientific and technical training and experience made them unique interpreters of the medieval geologist, and their notes on the text are important contributions to the modern literature of geology. They say of Agricola: "In his propositions as to the circulation of ground waters, that ore channels are a subsequent creation to the contained rocks, and that they were filled by deposition from circulating solutions, he enunciated the foundations of our modern theory, and in so doing took a step in advance greater than that of any single subsequent authority." The extract below is from one of Mr. Hoover's notes on the translation. It elaborates his estimate of Agricola's part in the history of mining geology.

Georgius Agricola DE RE METALLICA, translated from the first Latin edition of 1556 with Biographical Introduction, Annotations and Appendices upon the Development of Mining Methods, Metallurgical Processes, Geology, Mineralogy and Mining Law from the earliest times to the Sixteenth Century by HERBERT CLARK HOOVER . . . and LOU HENRY HOOVER . . . Published for the Translators by The Mining Magazine, Salisbury House, London, E. C., 1912.

Historical Note on the Theory of Ore Deposits

Prior to Agricola there were three schools of explanation of the phenomena of ore deposits, the orthodox followers of the Genesis, the Greek Philosophers, and the Alchemists. The geology of the Genesis—the contemporaneous formation of everything—needs no comment other than that for anyone to have proposed an alternative to the dogma of the orthodox during the Middle Ages, required much independence of mind. Of the Greek views—which are meagre enough—that of the Peripatetics greatly dominated thought on natural phenomena down to the seventeenth century. Aristotle's views may be summarized: The elements are earth, water, air, and fire; they are transmutable and never found pure, and are endowed with certain fundamental properties which acted as an "efficient" force upon the material cause—the elements. These properties were dryness and dampness and heat and cold, the latter being active, the former passive. Further, the elements were possessed of weight and lightness, for instance earth was absolutely heavy, fire absolutely light. The active and passive properties existed in binary combinations, one of which is characteristic, *i. e.*, "earth" is cold and dry, water damp and cold, fire hot and dry, air hot and wet; transmutation took place, for instance, by removing the cold from water, when air resulted (really steam), and by removing the dampness from water, when "earth" resulted (really any dissolved substance). The transmutation of the elements in the earth (meaning the globe) produces two "exhalations", the one fiery (probably meaning gases), the other damp (probably meaning steam). The former produces stones, the latter metals. Theophrastus (On Stones, I to VII) elaborates the views of Aristotle on the origin of stones, metals, etc.: "Of "things formed in the earth some "have their origin from water, others "from earth. Water is the basis of "metals, silver, gold, and the rest; "'earth' of stones, as well the more "precious as the common . . . All "these are formed by solidification of "matter pure and equal in its con-"stituent parts, which has been brought "together in that state by mere afflux "or by means of some kind of perco-"lation, or separated. . . . The solidi-"fication is in some of these substances "due to heat and in others to cold." (Based on Hill's Trans., pp. 3-11). That is, the metals inasmuch as they become liquid when heated must be in a large part water, and, like water, they solidify with cold. Therefore, the "metals are cold and damp". Stones, on the other hand, solidify with heat and do not liquefy, therefore, they are "dry and hot" and partake largely of "earth". This "earth" was something indefinite, but purer and more pristine than common clay. In discussing the ancient beliefs with regard to the origin of deposits, we must not overlook the import of the use of the word "vein" (*vena*) by various ancient authors including Pliny (XXXIII, 21), although he offers no explanation of the term.



A—Descending into the shaft by ladders. B—By sitting on a stick. C—By sitting on the dirt. D—Descending by steps cut in the rock.

SIXTEENTH CENTURY METHODS of descending into a mine. From De Re Metallica

During the Middle Ages there arose the horde of Alchemists and Astrologers, a review of the development of whose muddled views is but barren reading. In the main they held more or less to the Peripatetic view, with additions of their own. Geber (13th (?) century . .)pronounced the conception that all metals were composed of varying proportions of "spiritual" sulphur and quicksilver, and to these Albertus Magnus added salt. The Astrologers contributed the idea that the immediate cause of the metals were the various planets. The only work devoted to description of ore deposits prior to Agricola was the *Bergbüchlin* (about 1520), and this little book exhibits the absolute apogee of muddled thought derived from the Peripatetics, the Alchemists, and the Astrologers. . . .

Agricola's Views on the Origin of Ore Deposits

Agricola rejected absolutely the Biblical view which, he says, was the opinion of the vulgar; further, he repudiates the alchemistic and astrological view with great vigor. There can be no doubt, however, that he was greatly influenced by the Peripatetic philosophy. He accepted absolutely the four elements—earth, fire, water, and air, and their "binary" properties, and the theory that every substance had a material cause operated upon by an efficient force. Beyond this he did not go, and a large portion of *De Ortu et Causis* is devoted to disproof of the origin of metals and stones from the Peripatetic "exhalations".

No one should conclude that Agricola's theories are set out with the clarity of Darwin or Lyell. However, the matter is of such importance in the history of the theory of ore deposits, and has been either so ignored or so colored by the preconceptions of narrators, that we consider it justifiable to devote the space necessary to a reproduction of his own statements in *De Ortu et Causis* and other works. Before doing so we believe it will be of (*Turn to next page*)

Hoover on Ore Deposits—*Continued*

service to readers to summarize these views, and in giving quotations from the Author's other works, to group them under special headings, following the outline of his theory given below. His theory was:

(1) Openings in the earth (*canales*) were formed by the erosion of subterranean waters.

(2) These ground waters were due (*a*) to the infiltration of surface waters, rain, river, and sea water; (*b*) to the condensation of steam (*halitus*) arising from the penetration of the surface waters to greater depths—the production of this *halitus* being due to subterranean heat, which in his view was in turn due in the main to burning bitumen (a comprehensive genera which embraced coal).

(3) The filling of these *canales* is composed of "earth", "solidified juices", "stone", metals and "compounds", all deposited from water and "juices" circulating in the *canales*.

"Earth" comprises clay, mud, ochre, marl, and "peculiar earths" generally. The origin of these "earths" was from rocks, due to erosion, transportation, and deposition by water. "Solidified juices" (*succi concreti*) comprised salt, soda, vitriol, bitumen, etc., being generally those substances which he conceived were soluble in and deposited from water. "Stones" comprised precious, semi-precious, and unusual stones, such as quartz, fluor-spar, etc., as distinguished from country rock; the origin of these he attributed in minor proportion to transportation of fragments of rock, but in the main to deposits from ordinary mineral juice and from "stone juice" (*succus lapidescens*). Metals comprised the seven traditional metals; the "compounds" comprised the metallic minerals; and both were due to deposition from juices, the compounds being due to a mixture of juices. The "juices" play the most important part in Agricola's theory. Each substance had its own particular juice, and in his theory every substance had a material and an efficient cause, the first being the juice, the second being heat or cold. Owing to the latter the juices fell into two categories—those solidified by heat (*i. e.*, by evaporation, such as salt), and those solidified by cold (*i. e.*, because metals melt and flow by heat, therefore their solidification was due to cold, and the juice underwent similar treatment). As to the origin of these juices, some were generated by the solution of their own particular substance, but in the main their origin was due to the combination of "dry things", such as "earth", with water, the mixture being heated, and the resultant metals depended upon the proportions of "earth" and water. In some cases we have been inclined to translate *succus* (juice) as "solution", but in other cases it embraced substances to which this would not apply, and we feared implying in the text a chemical understanding not warranted prior to the atomic theory. In order to distinguish between earths (clays, etc.,) the Peripatetic "earth" (a pure element) and the earth (the globe) we have given the two former in quotation marks. There is no doubt some confusion between earth (clays, etc.,) and the Peripatetic "earth", as the latter was a pure substance not found in its pristine form in nature; it is, however, difficult to distinguish between the two. . . .

Conclusion

If we strip his theory of the necessary influence of the state of knowledge of his time, and of his own deep classical learning, we find two propositions original with Agricola, which still today are fundamentals:

(1) That ore channels were of origin subsequent to their containing rocks; (2) that ores were deposited from solutions circulating in these openings. A scientist's work must be judged by the advancement he gave to his science, and with this gauge one can say unhesitatingly that the theory which we have set out above represents a much greater step from what had gone before than that of almost any single observer since. Moreover, apart from any tangible proposition laid down, the deduction of these views from actual observation instead of from fruitless speculation was a contribution to the very foundation of natural science. Agricola was wrong in attributing the creation of ore channels to erosion alone, and it was not until Von Oppel (*Anleitung zur Markscheidekunst*, Dresden, 1749 and other essays), two centuries after Agricola, that the positive proposition that ore channels were due to fissuring was brought forward. Von Oppel, however, in neglecting channels due to erosion (and in this term we include solution) was not altogether sound. Nor was it until late in the eighteenth century that the filling of ore channels by deposition from solutions was generally accepted. In the meantime, Agricola's successors in the study of ore deposits exhibited positive retrogression from the true fundamentals advocated by him. Gesner, Utman, Meier, Lohneys, Barba, Rössler, Becher, Stahl, Henckel, and Zimmerman, all fail to grasp the double essentials. Other writers of this period often enough merely quote Agricola, some not even acknowledging the source, as, for instance, Pryce (*Mineralogia Cornubiensis*, London, 1778) and Williams (Natural History of the Mineral Kingdom, London, 1789). After Von Oppel, the two fundamental principles mentioned were generally accepted, but then arose the complicated and acrimonious discussion of the origin of solutions, and nothing in Agricola's view was so absurd as Werner's contention (*Neue Theorie von der Entstehung der Gänge*, Freiberg, 1791) of the universal chemical deluge which penetrated fissures open at the surface. While it is not the purpose of these notes to pursue the history of these subjects subsequent to the author's time, it is due to him and to the current beliefs as to the history of the theory of ore deposits, to call the attention of students to the perverse representation of Agricola's views by Werner (op. cit.) upon which most writers have apparently relied. Why this author should be . . . so generally considered the father of our modern theory, can only be explained by a general lack of knowledge of the work of previous writers on ore deposition. Not one of the propositions original with Werner still holds good, while his rejection of the origin of solutions within the earth itself halted the march of advance in thought of these subjects for half a century. It is our hope to discuss exhaustively at some future time the development of the history of this, one of the most far-reaching of geologic hypotheses.

Georgius Agricola (1490-1555), whose name was originally Bauer, began his scholarly life at 20 as teacher of Greek at Zwickau, Saxony, but continued studying and eventually mastered physics, chemistry and medicine. At about 32 he located as a physician in the mining region of Joachimsthal. There he observed the mining art in the scientific spirit and described it in a number of books, of which *De Re Metallica* is the most comprehensive. It was written in 1550, but was not published until the year after the author's sudden death—which was brought on by excitement in a dispute on religion.

Herbert Clark Hoover (1874—) and **Lou Henry Hoover**, while living at Red House in London, in the lull between Mr. Hoover's mining career and his war-time service, found time for their translation of *De Re Metallica*, a monumental work of scholarship in mining history. Mr. Hoover's life has fallen into four periods: as mining engineer, to 1914; as Relief and Food Administrator, to 1920; as Secretary of Commerce, to 1928; and as President of the United States, beginning this year.